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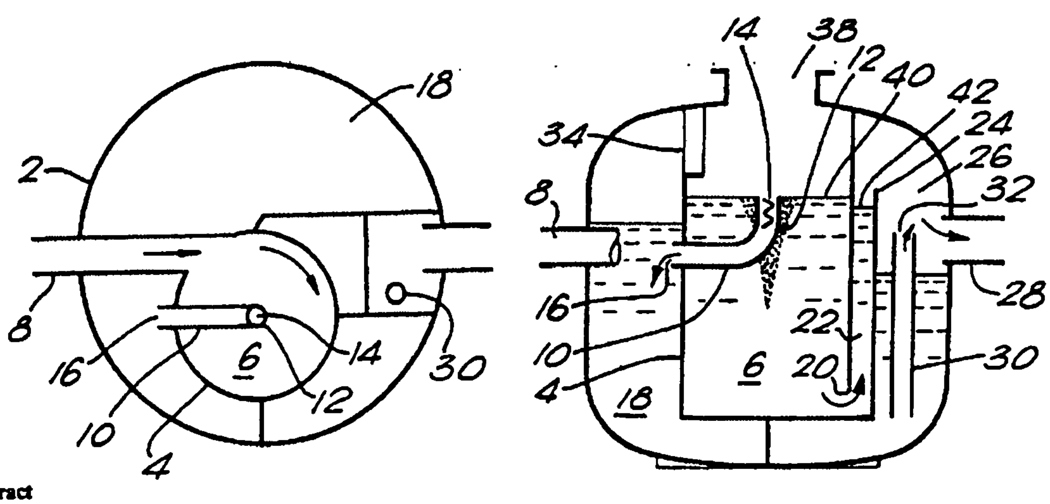

(57) Abstract

An interceptor unit for preventing oily matter from reaching the mains drainage system comprises a separator chamber (6) and a storage chamber (18). Incoming rainwater and oily matter enter the separator chamber (6) through a tangential inlet (8), and circulate to provide a separating effect. The oily matter floats to the top and passes through a transfer duct (10) to the storage chamber (18). A dip pipe (30) extends from the bottom of the storage chamber (18), where the water is relatively uncontaminated, to an outlet box (26), so that only clean water reaches the outlet (28). Under heavy flow, relatively clean water from the lower region of the separator chamber (6) can reach the outlet box (26) by flowing through a waterway (22). In the event of a major oil or fuel spillage, the oil or fuel at the top of the separator chamber (6) can flow to the storage chamber (18) through an overflow opening (34).

INTERCEPTORS

This invention relates to interceptors, and particularly to interceptors for separating hydrocarbons such as lubricating oil and fuels from water before the water is discharged to the mains drainage system.

Water authorities are required to prevent pollutants, for example oily materials such as lubricating oils and fuels, from entering the mains drainage system. Consequently, interceptors are provided between the source of any such pollution (such as a filling station forecourt) and the mains drainage system. The function of these interceptors is to separate the pollutant from rainwater flowing towards the drainage system, and to store the pollutants until they can be removed for disposal.

Under normal conditions, such interceptors need cope only with small spillages of oily material, and moderate rainfall. Under these conditions, the residence time of the oil/water mix in the interceptor is sufficiently long to enable the oily material to separate from the water under gravity, so that the water entering the mains drainage system is substantially free of oil. However, under conditions of very heavy rainfall, or where a large spillage of oily material takes place, there is the danger that the interceptor will be overloaded and lubricating oil or fuel will pass to the mains drainage system.

GB2167689 discloses interceptors which have a preliminary separator. Under normal conditions, all oil/water mixture reaching the preliminary separator is passed to a storage chamber, but under storm conditions the preliminary separator passes only relatively heavily contaminated water to the storage chamber, while relatively clean water is diverted directly to the outlet, and so is discharged to the mains drainage

system without any further separation taking place under quiescent conditions. Although such separators work well, the oil-laden water passing to the interceptor under storm conditions is at a relatively high pressure, and special measures need to be taken in order to avoid excessive turbulence in the interceptor which could results in some oil and fuel being discharged to the mains drainage system.

According to the present invention, there is provided an interceptor unit comprising a storage chamber and a separator chamber, the separator chamber having an inlet which is directed to promote a circulating flow within the separator chamber about an upwardly extending axis, a transfer duct being provided which has an upwardly directed inlet disposed within the separating chamber, and an outlet disposed within the storage chamber, the storage chamber communicating with an outlet through a dip pipe which extends upwardly from a lower region of the storage chamber, and the separator chamber communicating with the outlet through a waterway which extends from the lower region of the separator and discharges to the outlet over a weir which is disposed above the inlet of the transfer duct.

The inlet of the transfer duct is preferably disposed at, or close to, the axis of the circulating flow within the separator chamber. When an oil/water mixture circulates in the separator chamber, the oil tends to coalesce at the swirl axis and towards the top of the separator chamber, and so the flow into the transfer duct will contain a relatively high proportion of oil or fuel compared to any liquid flowing from the separator chamber to the outlet through the waterway.

Because the flow within the separator chamber is a circulating flow, the surface of the fluid within the separator chamber, particularly under storm conditions

when the flow rate into the separator chamber is high, will not be horizontal, but will assume a generally parabolic shape. Consequently, the liquid level at the inlet of the transfer duct will be relatively low compared to the liquid level at the wall of the separator chamber. Thus the pressure head above the inlet to the transfer duct will be relatively small, whereas the pressure head at the wall of the separator chamber, which balances the hydrostatic pressure within the waterway, is relatively high. The result of this is that the pressure drop across the transfer duct will not increase significantly as the flow rate into the separator chamber increases, and so the flow rate through the transfer duct will remain substantially constant, so avoiding turbulence in the storage chamber.

For a better understanding of the present invention, and to show how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a diagrammatic plan view of an interceptor;

Figure 2 is a diagrammatic side view of the interceptor of Figure 1, and

Figure 3 corresponds to Figure 2, but shows the interceptor operating under storm conditions.

Referring to Figures 1 and 2, the interceptor comprises an outer casing 2 which accommodates an inner vessel 4 defining a separator chamber 6. An inlet duct 8 extends through the casing 2 and opens tangentially into the vessel 4 so that flow entering the separator chamber 6 through the inlet 8 promotes a circulating flow within the separator chamber 6.

The separator chamber 6 is provided with a transfer duct 10 which has an upwardly extending portion 12 terminating at an inlet opening 14. The

transfer duct 10 opens outside the vessel 4 at an outlet 16. Flow from the separator chamber 6 which enters the transfer duct 10 through the inlet opening 14 is thus discharged into the space between the vessel 4 and the casing 2, which space constitutes a storage chamber 18.

The separator chamber 6 has an outlet opening 20 at its lower region which opens into an upwardly extending waterway 22. Liquid entering the waterway 22 is discharged over a weir 24 into an outlet box 26, from which an outlet pipe 28 extends. The weir 24 is at a level above that of the inlet 14 of the transfer duct 10.

A dip pipe 30 extends from the lower region of the storage chamber 18 into the outlet box 26, terminating at an upwardly facing outlet 32, which is at a level above that of the outlet 16 of the transfer duct 10.

The wall of the vessel 4 has an opening 34 at its upper region, above the level of the opening 14 of the transfer duct 10, which provides communication between the separator chamber 6 and the storage chamber 18. More particularly the bottom edge of the opening 34 is above the maximum water level reached in the separator chamber 6 when the incoming flow contains little oily matter.

The casing 2 is provided with an upper opening 38 constituting a man hole for providing access to the interior of the casing 2 when the interceptor is installed underground.

Figure 2 represents the interceptor during normal operation, i.e. when rainwater runoff from the surrounding area (such as a filling station forecourt) into the interceptor is at a relatively low level, and when the rainwater carries with it only minor spillages of lubricating oil or fuel. The flow through the inlet 8 is at a relatively low rate, and so, although the

mixture within the separator chamber 6 circulates, it does so slowly and the surface 40 of the mixture within the separator chamber 6 can be regarded as horizontal.

Under static conditions, the surface 40 is at the inlet 14 of the transfer duct 10, and so any further flow through the inlet 8 is accompanied by flow of the upper layer of mixture in the separator chamber 6 through the transfer duct 10 into the storage chamber 18. It will be appreciated that any pollutants such as lubricating oil or fuel in the mixture in the separator chamber 6 will tend to coalesce at the surface 40, and so the liquid reaching the storage chamber 18 will have a relatively high proportion of pollutants. The waterway 22, since it is supplied from the lower region of the separator chamber 6, will contain water which is substantially unpolluted by lubricating oil or fuel. Its surface 42 is shown somewhat lower than the surface 40, because the mixture in the separator chamber 6, containing lubricating oil and fuel, will have a slightly lower average specific gravity than the water in the waterway 22.

Liquid entering the storage chamber 18 through the transfer duct 10 will displace an equal volume of substantially clean water through the dip pipe 30 into the outlet box 26, from which it will flow through the outlet 28 to the mains drainage system. Any lubricating oil or fuel entering the interceptor through the inlet 8 will, therefore, be trapped near the surface of the body of liquid within the storage chamber 18, for periodic extraction through the opening 38, and subsequent disposal.

Under storm conditions, when the flow rate through the inlet 8 increases, the interceptor operates in a somewhat different manner, as will be described with reference to Figure 3.

Because the flow rate through the inlet 8 is

relatively high, the flow within the separator chamber 6 will circulate relatively quickly, and this will cause the surface 40 to assume a generally parabolic shape, as illustrated in Figure 3. The mixture within the separator chamber 6 will, as before, flow into the transfer duct 10 and thence to the storage chamber 18, but, because the inlet 14 is disposed at the lowest point of the parabolic surface 40, the static head above the inlet 14 will not be significantly higher than occurs under the conditions represented in Figure 2, and so the flow rate through the transfer duct 10 will not increase significantly. Under storm conditions, the flow through the inlet 8 will be greater than the flow through the transfer duct 10, and the excess flow will raise the level 42 of the water in the waterway 22 until it flows over the weir 24 into the outlet box 26. The relatively rapid circulating flow within the separator chamber 6 will cause any oil or fuel to move towards the axis of the circulating flow, so that, as before, the water flowing into the waterway 22 will be substantially uncontaminated. The water overflowing the weir 24 into the outlet box 26 will contribute to the static pressure head within the dip tube 30, enabling the liquid level 36 in the storage chamber 18 to rise temporarily, so increasing the residence time of liquid within the storage chamber 18. Since an increased residence time increases the separating efficiency within the storage chamber 18, this effect reduces the level of pollutants reaching the outlet 28 through the dip pipe 30.

Thus, under storm conditions, an initial separation of water and pollutants takes place in the separator chamber 6, and substantially uncontaminated water is diverted directly to the outlet box 26 without passing into the storage chamber 18. Because the surface 40 assumes a parabolic form under storm

conditions, the static pressure head at the inlet 14 of the transfer duct 10 is kept relatively low, so avoiding any increase in flow rate through the transfer duct 10 into the storage chamber 18 when increased flow takes place through the inlet 8.

If a serious spillage of oil or fuel takes place, for example if an accidental discharge of fuel from a tanker occurs, then the fuel, possibly mixed with some water, will flow through the inlet 8 at a high flow rate into the separator chamber 6. The surface of the mixture in the separator chamber 6 will assume the parabolic form shown in Figure 3, but, because of the low specific gravity of the incoming fuel, the level in the separator chamber 6 will be able to rise significantly, balanced by the higher specific gravity water in the waterway 22. Under these conditions, the level will rise above the lower edge of the opening 34, and the fuel at the surface of the mixture in the separator chamber 6 will overflow directly into the storage chamber 18. Thus, although some of the fuel spillage will pass through the transfer duct 10 into the storage chamber 18, the excess (which will consist almost entirely of the fuel) will flow rapidly to the storage chamber 18 through the opening 34. The level of the lower edge of the opening 34 is situated above the normal maximum height which will be reached by the liquid in the separator chamber under high flow conditions (Figure 3) before overflow takes place over the weir 24. However, because the column of water in the waterway 22 can support a higher body of less dense oily material, the level in the separator chamber 6 can rise to that of the lower edge of the opening 34 when a large quantity of oily material enters the interceptor.

The interceptor described above is thus not only capable of coping with normal spillage and rainfall, but can also accommodate storm conditions and major

spillages without the danger of oil or fuel being passed, in significant quantities, to the mains drainage system. Although not shown, the interceptor may be provided with level detectors and other monitoring equipment for providing appropriate signals when the interface between the water and oily matter in the storage chamber 18 reaches a predetermined level at which the oily matter should be removed.

CLAIMS

1. An interceptor unit comprising a storage chamber and a separator chamber, the separator chamber having an inlet which is directed to promote a circulating flow within the separator chamber about an upwardly extending axis, a transfer duct being provided which has an upwardly directed inlet disposed within the separator chamber, and an outlet disposed within the storage chamber, the storage chamber communicating with an outlet through a dip pipe which extends upwardly from a lower region of the storage chamber, and the separator chamber communicating with the outlet through a waterway which extends from the lower region of the separator chamber and discharges to the outlet over a weir which is disposed above the inlet of the transfer duct.

2. An interceptor unit as claimed in claim 1, in which the dip pipe has an outlet opening disposed above the outlet of the transfer duct.

3. An interceptor unit as claimed in claim 1 or 2, in which the inlet of the transfer duct is preferably disposed at, or close to, the axis of the circulating flow within the separator chamber.

4. An interceptor unit as claimed in any one of the preceding claims, in which the transfer duct comprises a pipe which extends through the wall of the separator chamber and has a vertical section situated within the separator chamber, the vertical section terminating at its upper end at the inlet.

5. An interceptor unit as claimed in any one of the preceding claims, in which the outlet of the unit extends from an outlet box into which the dip pipe and the waterway discharge.

6. An interceptor unit as claimed in any one of the preceding claims, in which the separator chamber communicates with the storage chamber through an

overflow opening situated above the inlet of the transfer duct.

7. An interceptor unit as claimed in claim 6, in which the overflow opening is provided in the wall of the separator chamber, and has a horizontal lower edge at a level above the inlet of the transfer duct.

8. An interceptor unit as claimed in any one of the preceding claims, in which the outlet of the transfer duct and the inlet of the dip pipe are situated so as to provide a long flow path for liquid flowing between them.

9. An interceptor unit as claimed in any one of the preceding claims, in which monitoring means is provided for monitoring an interface between immiscible liquids in the storage chamber.

10. An interceptor unit as claimed in any one of the preceding claims, in which the storage chamber is defined by an outer casing within which the separator chamber is situated.

FIG.1.

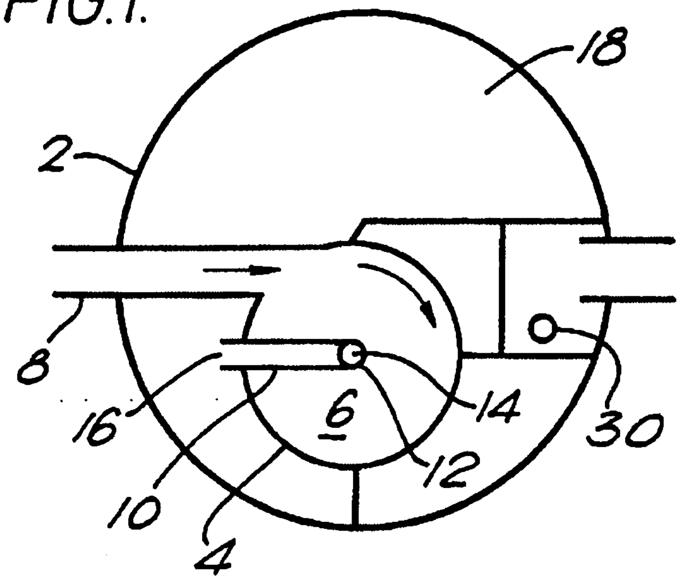
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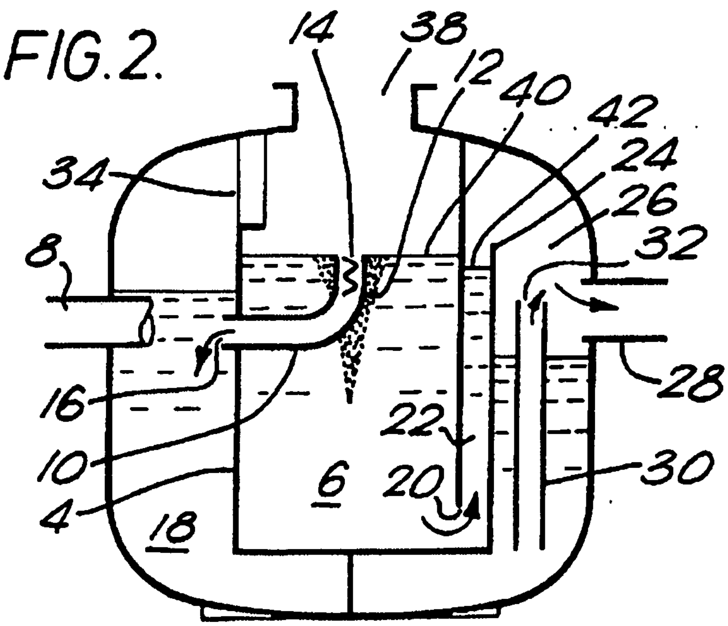
FIG.2.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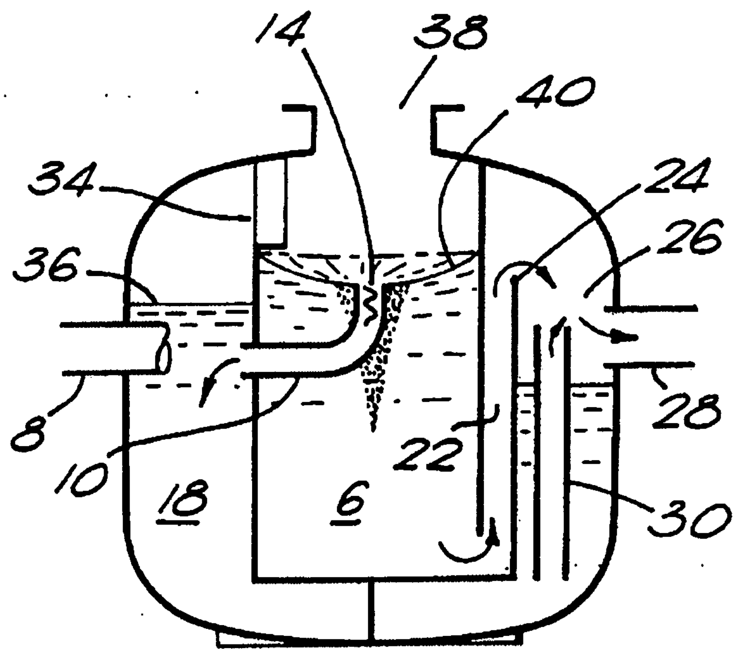

FIG.3.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00211

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 01 D 17/038, E 03 F 5/16, B 01 D 17/032

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 01 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y,A	GB, A, 2167689 (JOHN HILL-VENNING) 4 June 1986, see claims; figures cited in the application --	1-6,8-10
Y	US, A, 3444077 (FINCH) 13 May 1969, see column 1, lines 10-25,56,57; column 2, lines 45-58; figure 3 --	1-6,8,10
Y	DE, A, 2436080 (RACOR INDUSTRIES) 22 May 1975, see page 23, paragraph 2 - page 25, paragraph 1 --	9
Y	DE, A, 2114506 (REYNOLDS SUBMARINE SERVICES) 5 October 1972, see page 6, last paragraph --	9
A	US, A, 4483774 (BRILL) 20 November 1984, see abstract; figure 1; column 4, lines 28-60 ----	1,3,4

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21st June 1989	11.07.89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8900211
SA 27532

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2167689	04-06-86	None	
US-A- 3444077	13-05-69	None	
DE-A- 2436080	22-05-75	US-A- 3931011	06-01-76
		AU-A- 6999774	11-12-75
		CA-A- 1032087	30-05-78
		GB-A- 1469288	06-04-77
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		FR-A- 2561126	20-09-85
		GB-A- 2155820	02-10-85
		JP-A- 60232211	18-11-85

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